MOLDING CONCRETE BATH TUBS, AQUARIUMS AND NATATORIUMS

MOLDING CONCRETE BATH TUBS, AQUARIUMS AND NATATORIUMS

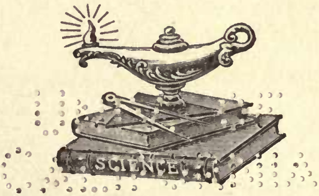
A PRACTICAL TREATISE

EXPLAINING THE MOLDING IN CONCRETE OF VARIOUS STYLES OF BATH TUBS, LAUNDRY TRAYS, ETC., WITH EASILY CONSTRUCTED MOLDS FOR THE PURPOSE. THE MOLDING OF AQUARIUMS AND NATATORIUMS, AS WELL AS THE WATER-PROOFING METHODS USED FOR SAME, ARE FULLY TREATED.

By

A. A. HOUGHTON

Author of "Concrete from Sand Molds," "Ornamental Concrete Without Molds," Etc., Etc.



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FOREWORD

It is the purpose of the writer to present in this series of books a complete explanation of various successful methods of concrete construction that may be employed by the beginner as well as by the more experienced worker. I shall endeavor to give the details of molds and ideas that are not covered by patents, such as may be easily and cheaply constructed; hence the reader is not compelled to purchase expensive patented molds before putting into practise the many successful types of concrete construction I have exhaustively described in this series. There is no practical value to the reader in explaining a patented system of construction, other than a few words on its merits, as the owners of same are always pleased to give this information; hence in going outside the beaten track of concrete authors and presenting ideas, systems, and molds that are practical, successful in operation, and, above all, easily and simply constructed, I trust that I have merited the sincere gratitude of all fellow workers in the concrete field who seek such information.

Yours very truly,

A. A. Houghton.

PREFACE

The writer has endeavored to treat the subject of molding concrete bath tubs in a complete manner, employing only such molds as are certain of success, as well as having the advantage of being easily and simply constructed.

The close imitation of the usual type of marble, metal or composition tub is not essential, even if it is desirable, as concrete is an entirely different material, demanding more massive lines to be durable; hence, other than upon the point of use, the concrete bath tub should be molded and sold as concrete, and upon its merits as concrete, and not as an imitation of any other material.

This, of course, should not be construed to mean that the molding of smooth, glossy concrete that will reflect light, like polished stone, in any manner detracts from the beauty of the material, nor can this be judged to be an imitation of stone, as this is but an artificial finish to any product, and is as permissible for concrete as for any other material.

The simple construction of the molds for this work, as are fully illustrated in this volume, will convince the reader that the molding of concrete

bath tubs is extremely practical, and that there should be a most excellent sale for the finished product in competition with the marble and metal tubs for this purpose, as a concrete bath tub may be molded and sold at a price far less than of other material, and yet yield the worker a good profit for his work.

Concrete may also be made an ideal material for aquariums, as it is for natatoriums. The simple and easy method of molding the work with glass inserted into the sides, will be of interest to those who have contemplated any work of this kind.

Concrete laundry trays or tubs are extremely practical, and at the low cost of same, with the simplicity and ease of molding, should make them a profitable side line for every concrete plant.

The subject of water-proofing concrete is one of great interest, while the writer does not believe that the most positive and successful method for all classes of work has yet been discovered, yet a description of the best known methods and materials in use to-day may be of use and value to the reader who wants to make the best choice for the type of work under construction.

A. A. Houghton.

April, 1911.

TABLE OF CONTENTS

Molding Concrete Bath Tubs, Aquariums and Natatoriums

The concrete bath tub, as well as any article molded in concrete and intended to retain water, should be of such a mixture as to secure the maximum density of the concrete. This is an aid in making the work water-proof, as the closing of the pores is accomplished, thus demanding less treatment to make a thoroughly water-proof product.

To secure the maximum density, without pressure, the concrete must be of a wet mix, so that it can be poured and thus flow to every part of the mold. This permits the molds to have a smaller opening for placing the concrete than if the mixture was to be tamped into the molds.

The addition of from one-tenth and one-fourth to equal parts of hydrated lime, in proportion to the cement used, is also of value, as the extreme fineness of the lime causes it to fill the voids or pores in the concrete, thus increasing the density of the work. With a rich mixture of concrete and the addition of lime, usually about 25% of the weight of the cement, work may be molded by the wet process that is practically water-proof; at the worst demanding but the minimum of spe-

cial treatment to render it absolutely water-tight.

The sand for this work, when used for a bath tub or small aquarium, should run from coarse to fine particles, and be clean and sharp without the presence of any loam or clay; this may be tested by placing in water and allowing to settle, when the presence of any dirt may be easily detected. The necessity for clean and well-graded aggregate is greater where the work does not have the body or wall thickness to give it the needful strength.

The most successful mixture for a bath tub or small aquarium is secured when in the proportion of 1:3, using sand as the aggregate; to this may be added 25% of hydrated lime with beneficial results, based on the weight of the cement used. Thus, for each sack of cement, 25 pounds of lime are added to the mixture. The concrete should be wet enough to be poured from a pail into the molds or forms, pouring it slowly so to permit the grout to flow to all parts of the mold. This will insure the maximum density, as well as the strongest bond between the concrete and reinforcement, which should be added where the walls are less than 2 inches in thickness at any point.

CONSTRUCTION OF THE CORE

At Fig. 1, is shown one of the simplest forms of constructing a core for a concrete bath tub mold. This is built of sheet steel, bent over a wood form, to give it the shape or outline desired. This

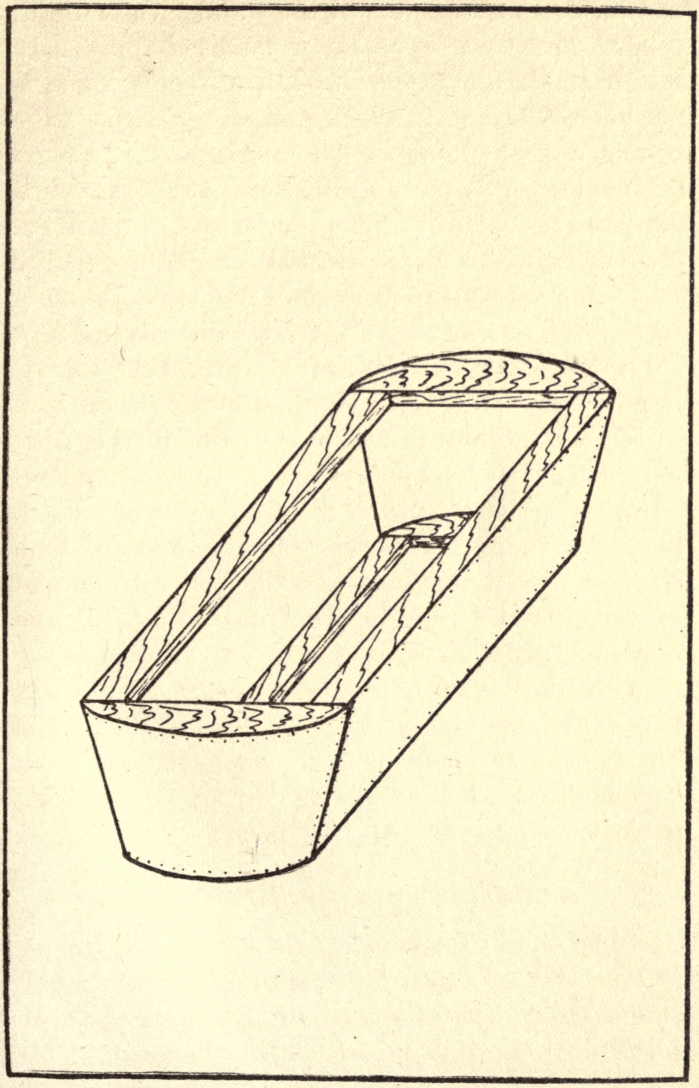

FIG. 1.—Construction of core for concrete bath tub.

should be less in width at the bottom than at the top, so to give a tapering or wedge-shaped form, which is the more easily drawn from the completed work.

The ends are cut in a convex form, as illustrated, and then securely fastened to two straight strips that make the sides of the core, at top and bottom of same. The sheet metal for the sides of the core should be No. 27 or 28 gauge, so to be the more easily bent to fit the wood form; that for the sides is cut the exact width and nailed to the wood strips at top and bottom. The bottom of mold is covered by a sheet of the metal, cut to fit the core form at bottom.

The core mold should be well coated with oil before use, or by giving two coats of enamel, the surface will be less liable to stick to the concrete, permitting the core to be withdrawn with ease and success.

While the core in illustrations is shown with oval ends, as that is the most satisfactory form, yet the worker may easily adapt the method of construction, to a square form as well as to any other type he may prefer.

MOLDS FOR BATH TUBS

As shown in the illustration at Fig. 2, the bath tub is molded bottom upward, which brings the trowel finish upon the bottom of the tub, and also permits the legs to be the more successfully

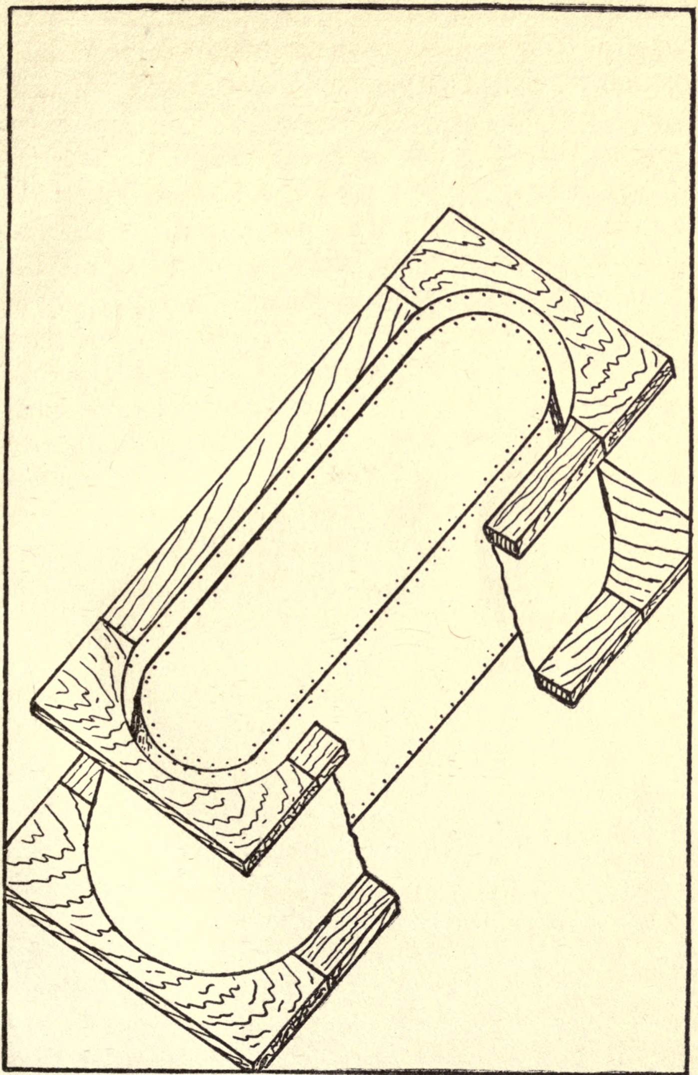

FIG. 2.—Mold for bath tub of concrete.

molded. The core form is inverted in the center of the molding board, or mold for the rim of tub, and is held in position by blocks or cleats nailed to the molding board. The forms or molds for the outside of tub are then placed around the core at an equal distance from same upon all sides, and when the reinforcement is in position it is then ready for the concrete to be poured.

The construction of the outside molds are clearly shown in Fig. 2; the two ends are formed by using concave strips of wood, cut to the size desired for the top and bottom of tub, and with the curve you desire for the outside at each end of tub. The sides of the mold are made from straight strips of the right length, and these are held against the end strips, when molding work, by strips of strap iron, fastened with screws and connecting the two pieces together. Thus the completed mold for outside of tub is composed of four sections, one for each end and two side sections; these are easily assembled by attaching the strap irons at each joint, and as easily removed from the completed work.

The inside of the wood strips is lined with sheet metal, using No. 27 or 28 gauge. This must be wide enough so that the outside mold will be at least 1½ inches above the core, when in position for molding, so as to mold the bottom of the tub. The inside or molding surface is coated with any good enamel, so to make a smooth molding sur-

face as well as to prevent the mold from sticking to the work.

The best thickness for the walls of a tub of this style is $1\frac{1}{4}$-inch for the sides, and $1\frac{1}{2}$ or 2 inches for the bottom, reinforced with wire cloth of $\frac{1}{2}$-inch mesh or expanded metal. The reinforcement is cut and bent into the form of tub and securely wired together, so that it may be simply set over the core form and will then be exactly in the center of the molded wall. The reinforcement may be modeled over the core form by laying or lightly nailing lath to the outside of the core, thus insuring that the complete reinforcement will be placed in the center of the wall. A special wood form may also be employed to build the reinforcing metal into the proper form, when time is of importance. The advantage in having a wall of $1\frac{1}{4}$ to $1\frac{1}{2}$ inches is that the weight of the completed tub is greatly reduced, thus making this style of tub practical for the purpose. The ample reinforcement will make a wall thickness of $1\frac{1}{4}$ inches, with a bottom thickness of $1\frac{1}{2}$ inches, strong enough for the work, and yet have the tub light enough to be easily moved when it is so desired.

The type of metal lined mold, illustrated in Fig. 2, is of the most durable construction, as there is no wood in contact with the concrete whatever. It also permits the outside metal to be cut from sheet steel ceiling plates, which are stamped with

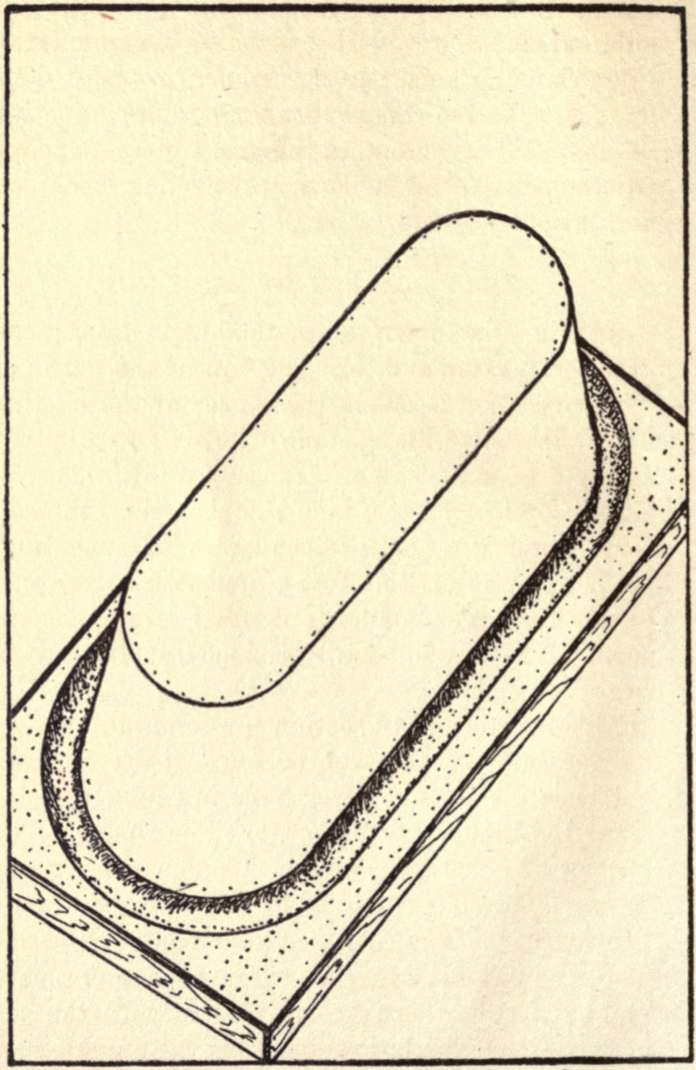

FIG. 3.—Plaster mold for rim of bath tub.

various ornamental forms, thus molding the outside surface of tub with bas-relief ornamentation upon same. This feature, when properly done, should make the concrete tub a strong competitor of the usual style among the great mass of people to whom price as well as appearance is of consideration.

MOLDS FOR RIM OF BATH TUB

At Fig. 3 is shown the method of making a concrete or plaster mold for the rim of the bath tub. The core form is set in the center of the molding board, inverted, and a square form of wood strips erected around same. These are 3 inches in height, and at least 6 inches larger than the core form upon all sides. The plaster or concrete is then tamped into this form, and with a trowel or gutter tool, the mortar is molded into a concave form of the exact shape desired for the rim of tub.

This may be cut in sections or remain in one entire section, as the worker may desire for convenience in storing. The work is easily removed from the mold in either case. The inside of the plaster or concrete mold for rim should be treated to two coats of shellac, so to give a smooth molding surface. When the completed mold is assembled, the outside form will rest upon this plaster mold for rim; this is usually filled with the concrete mixture for bath tub before the outside mold

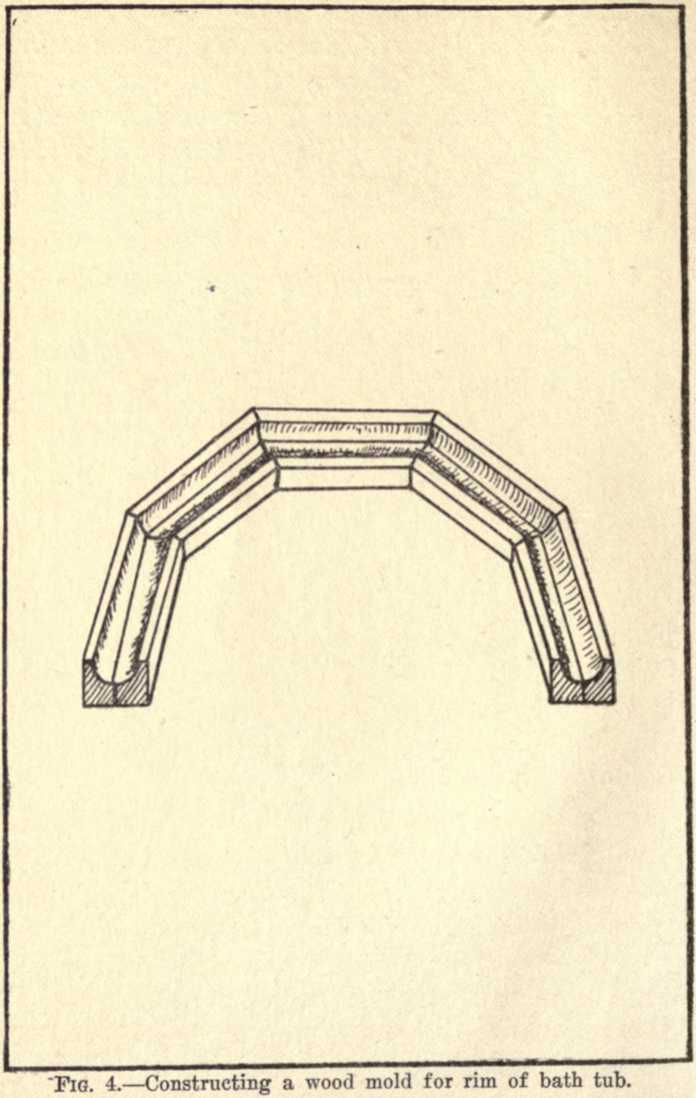

FIG. 4.—Constructing a wood mold for rim of bath tub.

is placed upon same, thus insuring that the rim will be perfectly molded.

Another style of mold for rim is shown in Fig. 4. This may be used upon tubs where the ends are constructed in the form shown in illustration, also as a rim mold upon the square style of concrete bath tub.

The mold is easily constructed by cutting strips of cove or scotia moulding, to join in the manner shown in the illustration at Fig. 4. The two concave sides of the moulding are joined together, so to make the semi-circular channel for the rim, the largest size of cove molding will be necessary so to give the rim a width of at least 2¼ inches. The height of the rim may be changed by planing off the top of the wood molding, if that is considered desirable.

The wood mold for rim must be well coated with shellac and also given a coating of oil before the work is molded, so that the wood will not absorb the moisture from the concrete, and also to prevent the concrete from adhering to same and thus spoiling the cast.

The mold for rim should be in several sections, so to be the more easily removed from the molded work. These may be held together when molding the tub by strips of strap iron fastened with screws, as explained for the outside sections of bath tub mold; or the sections may also be fastened together with hooks and eyelets upon the

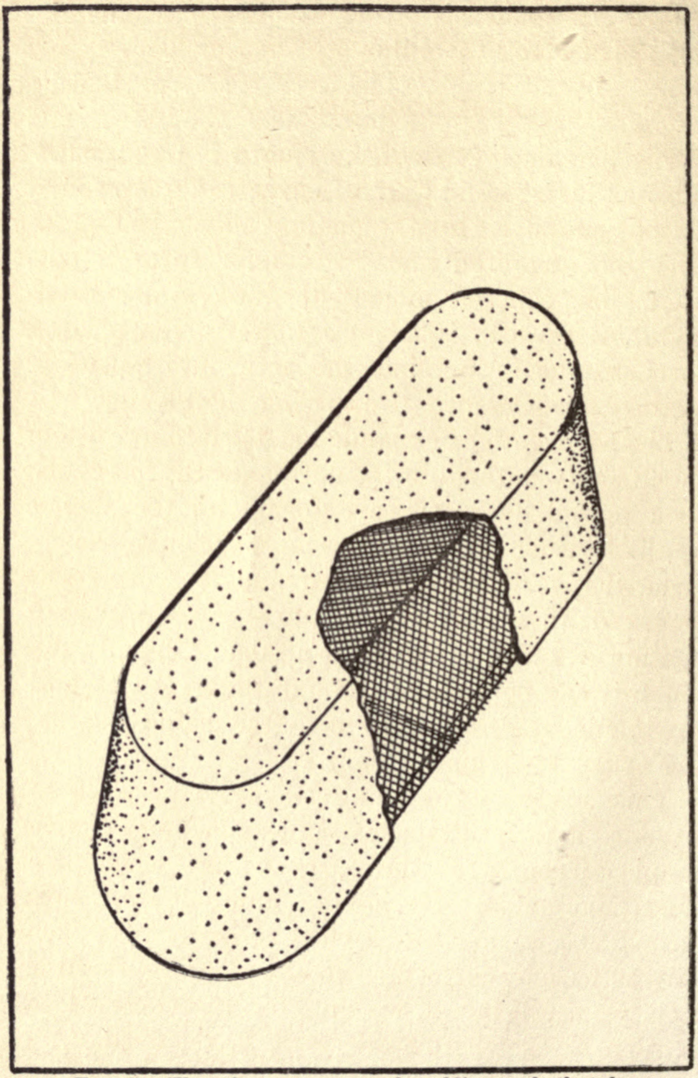

FIG. 5.—The plaster system of molding a bath tub.

outside, or by blocks of wood nailed to the molding board along the outside of rim mold.

THE PLASTER SYSTEM OF MOLDING

The plaster system of molding a concrete bath tub, as illustrated in Fig. 5, is practically the same as that employed for the method shown in Fig. 2, with the exception that the outside form is not used. The concrete mortar or stucco is plastered upon metal lath, which are placed over a core form, to aid in holding the lath into position against the pressure of applying the plaster.

The wire cloth or expanded metal lath are fitted together to conform to the outline of the bath tub, then placed over the core form and the stucco applied; when the concrete is sufficiently hardened, the work is turned over and the core form removed; then the inside of tub is given a plaster coating of cement mortar, if needed. Usually the mortar may be pressed through the wire lath and up against the core, so to make the inside plastering of the work unnecessary.

This system of molding makes it possible to produce a bath tub that is far less in weight, with ample strength for the purpose than when produced in molds. By having a number of core forms, the worker can perfect as many tubs each day as he may have time to complete, as there is not the necessity of waiting for the concrete to harden before the outside form is removed.

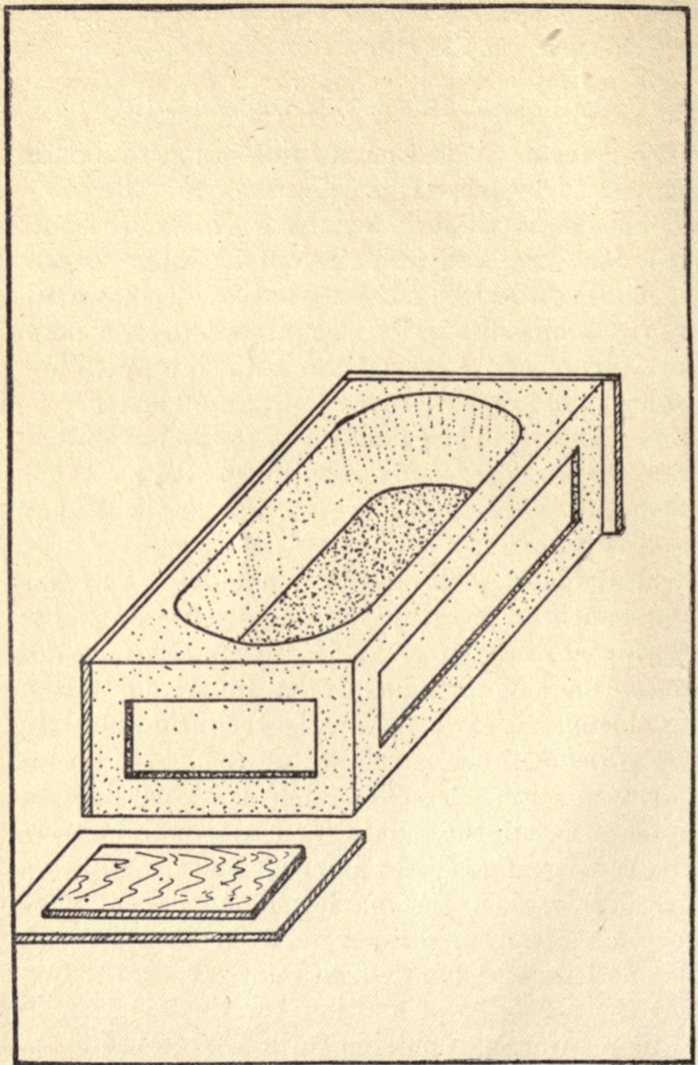

FIG. 6.—Molds for the square style of bath tub.

MOLDING THE SQUARE STYLE OF BATH TUB

The simplest style of molded bath tub is shown in Fig. 6. This requires a simple box form for the outside centering, or mold to the tub, which is ornamented by panels.

This style of tub is usually molded in the position it should occupy, as its weight does not make it possible to be moved very easily. To mold this upright, the core must be suspended in the proper position by strips placed across the top of the outside molds, and the concrete poured or tamped around core. By placing the concrete for the bottom of tub first, before setting the core form in the center of mold, the perfect molding of the bottom is assured.

The sides of tub may be ornamented by molding panels of concrete of a contrasting color to that used in the body of the tub, and then inserting in the outside molds at the proper point, thus producing an excellent appearance to the completed work. The panels to be imbedded into the concrete may be molded with a smooth, glossy surface, so to reflect light, by using glass slabs in the bottom of mold for panels, thus producing a very smooth surface to the molded panel. This method is fully described in No. 5 of this series on MOLDING AND CURING ORNAMENTAL CONCRETE.

In many residences where there is but little

room for the bath tub, and without any possibility of having a separate room for the purpose, the style of tub shown in Fig. 6 will be of value, as it can be equipped with a cover, which will also serve as a table top in the kitchen or any room in which the tub may be placed. This can be easily removed when it is desired to use the tub.

The details of constructing the outside forms for this style of bath tub is clearly shown in the illustration, and permit of many changes to suit the wishes of the worker.

MOLDING THE LEGS FOR BATH TUBS

The easiest method of molding the legs for a concrete bath tub is shown in Fig. 7. This requires that the outline of the legs be cut from a board of the right width, and this is then spaced the correct distance apart by tacking strips of tin or sheet metal to the edges of the wood forms, except at the point where the legs join onto the tub and also at the top of form, or the point upon legs that rest upon the floor, which is left open for convenience in pouring the concrete.

The mold for the legs should be placed upon the bottom of bath tub as soon as the bottom of same is finished, so that the concrete will be firmly bonded together. In event this is not done, the point where the legs are placed should have the aggregate exposed by scrubbing with a stiff brush

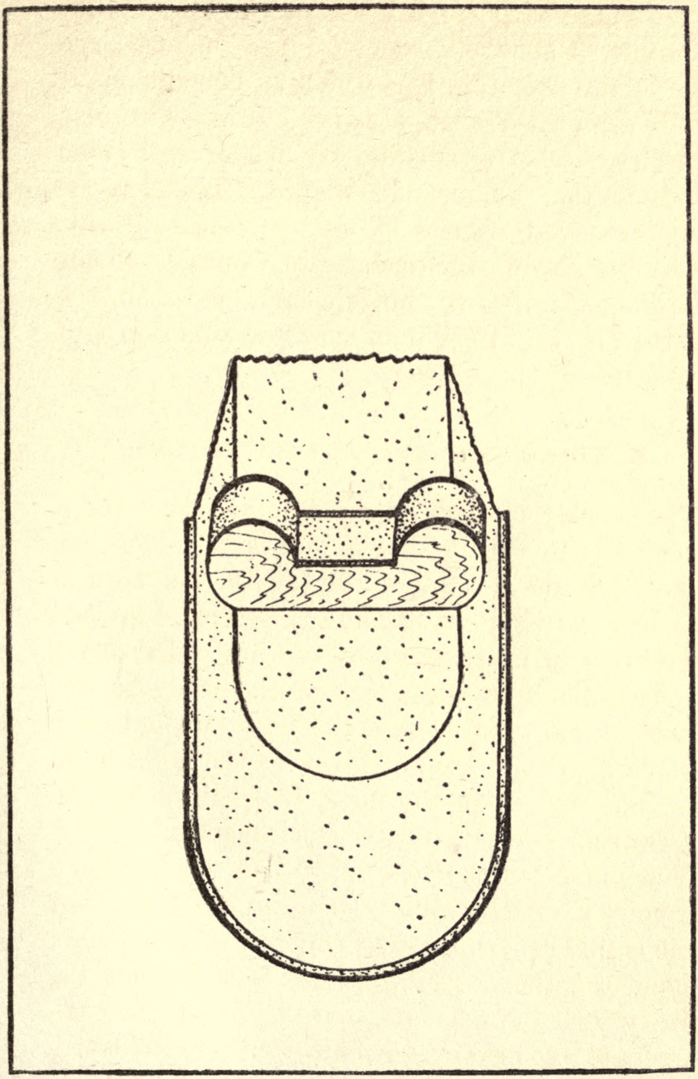

FIG. 7.—Molding legs to bath tubs.

and water, so that the concrete placed for the legs will be firmly bonded.

This permits the legs of tub to be placed at any point the worker may desire.

The method of cutting the wood outline of the legs is shown in Fig. 8, with several styles that may be employed for this purpose with excellent results.

The concrete bath tub, when molded in the reinforced type, is less in weight than a tub of marble, and about the weight of those in solid porcelain. The tub should be carefully water-proofed, and may be finished with a water-proof enamel upon both outside and inside surfaces, if desired.

MOLDING CONCRETE LAVATORIES

The lavatory shown in Fig. 9 is easily and simply molded in concrete. The bowl is molded in a square box form that has a moulding along the top edge, to produce the ornamented edge to same. The mold for the bowl may be made of an earthenware bowl or a small chopping-bowl of the right size, or it may also be formed in plaster or concrete to the desired shape. Openings are molded in the lavatory for the water supply pipes, to be placed, by inserting iron or wood plugs of the right size inside the mold at that point. These are well greased, so that the concrete cannot bond to same.

The bowl should also have metal strips molded

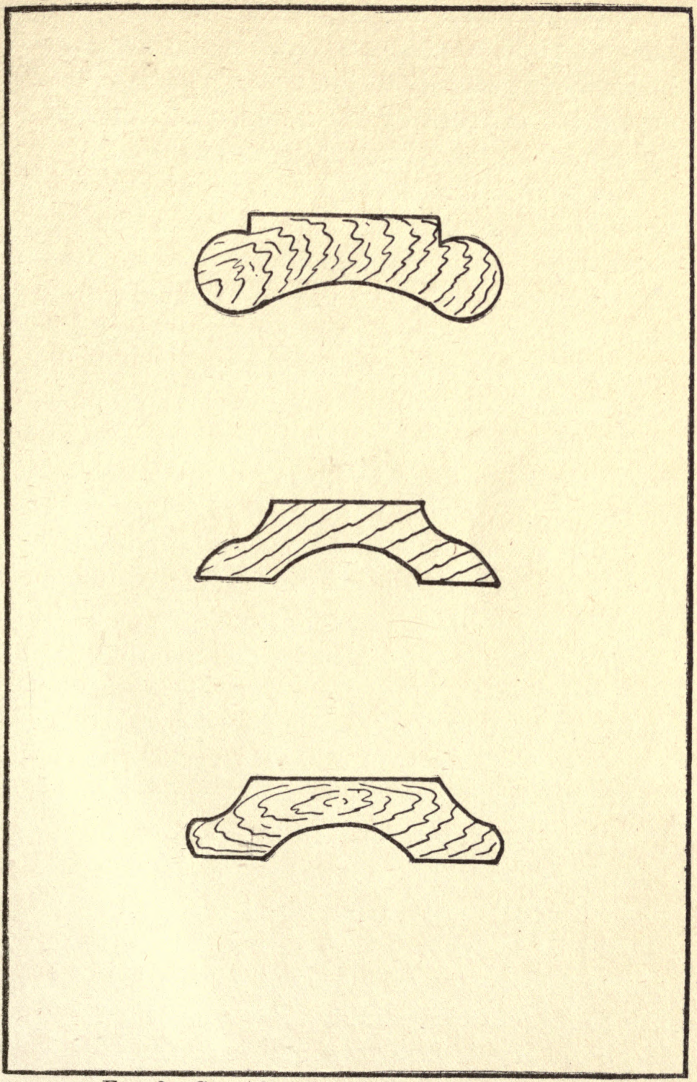

FIG. 8.—Several styles of legs for bath tubs.

so to project from the bottom of same. These are bent at right angles, and enable the lavatory to be fastened securely to the wall. The bowl is also supported in front by legs molded of concrete, or by employing metal legs for the purpose.

The slab at back of lavatory is the easiest molded in a square box form, that is lined upon three sides with wood moulding, so to produce an ornamental edge to the slab. If the face of slab is molded upon a sheet of glass, using a mixture of marble flour, white sand and white Portland cement, it will be very smooth and glossy and reflect light like polished marble. This may have openings molded in same for placing any water supply pipes, if so desired. The slab has a small $\frac{1}{4}$-inch hole molded at each corner, into which screws are placed for fastening the slab against the wall.

This lavatory may also be molded with larger legs, similar to those used for the laundry tub shown in Fig. 10, and thus it may be placed in the center of floor, instead of against the wall line.

An excellent style of lavatory may be molded by placing the core form in the center of molding board, around this a ring or circular form is placed, constructed from sheet metal; this circle should be at least 6 to 8 inches larger than the greatest diameter of the lavatory bowl, and from $2\frac{1}{2}$ to 3 inches in height. The concrete for bowl is placed inside this ring and over the core form

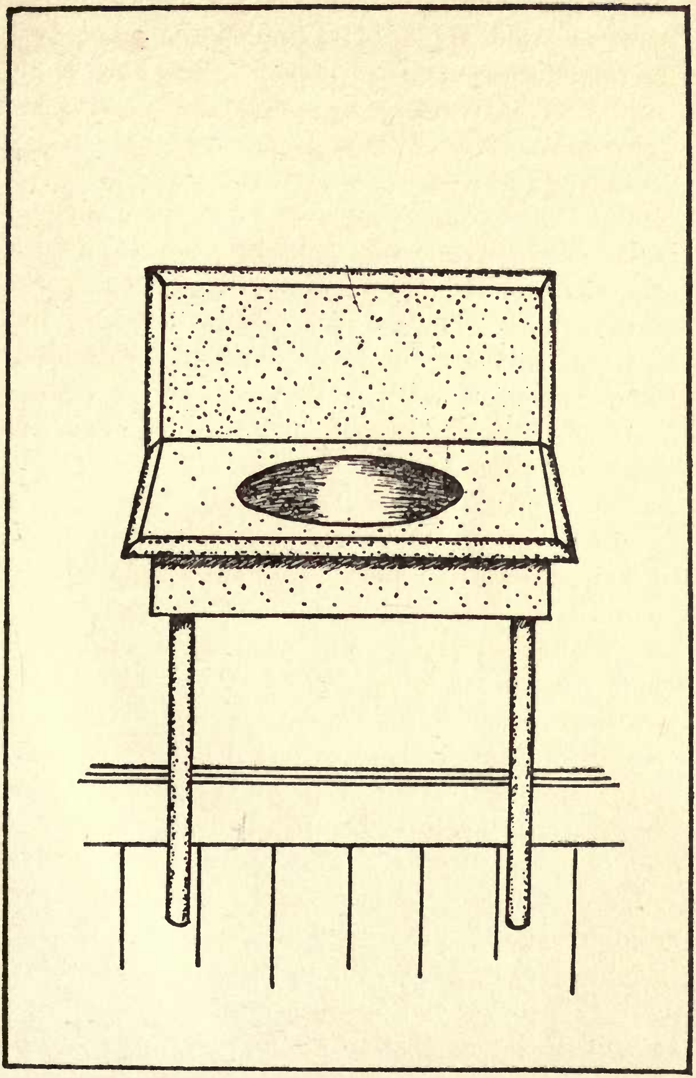

FIG. 9.—A lavatory that is easily molded in concrete.

for molding the bowl, to a depth of not less than 2 inches; where this is above the ring of metal, for outside form, the concrete can be molded with the trowel to form the shape desired. A short section of gas pipe is placed in the center of bowl, at the top, thus molding the opening for waste pipe. The pedestal to support the lavatory bowl is molded by using a cylinder of sheet metal, the exact size desired for the shaft, with a larger ring of about 2 or 3 inches in height to mold the base of pedestal. The shaft should be from 5 to 6 inches in diameter, and the base about 12 to 14 inches in diameter, and 2 or 3 inches high for a lavatory bowl of 18 to 22 inches in diameter and 9 to 11 inches in height. The concrete is first placed inside the mold for base of pedestal, and then the metal cylindrical mold for stem is placed upon same, and the concrete poured for stem or shaft. A section of gas pipe must be placed inside the shaft and base of pedestal, exactly in the center, to be used as the waste pipe to lavatory. The supply pipes may also be molded in the concrete, by inserting the supply pipes inside the lavatory bowl at the proper point; then if a $\frac{3}{4}$-inch supply pipe is to be used, place a $1\frac{1}{4}$-inch gas pipe, well greased, inside the mold for pedestal at the proper point for supply pipe. This permits the plumber to connect the supply pipe to those in bowl. Then place this inside the opening molded in pedestal, and finish the connection at the bottom of pedes-

tal after the bowl is placed upon top of pedestal. The waste pipe may project above the pedestal about $\frac{1}{8}$ of an inch more than the thickness of lavatory bowl at bottom, thus permitting the plumber to place a nut upon same, which not only makes the opening for waste pipe, but also holds the lavatory bowl upon the pedestal. This nut must be so placed that the top of same is flush with the bottom of bowl, allowing for mortar joint, so to permit the bowl to be absolutely cleaned each time it is emptied.

This style of molding may be employed for many different types of lavatories, as well as the manner of connecting same to the waste and water supply systems. The concrete lavatory is a most profitable line for the worker, as it enters into competition with other materials that command a high price, hence the profit for the work would be large. By using a good marble mixture for your concrete, the work would be of a quality that would enable it to successfully compete with any other material.

This is as easily applied to many styles of bowls for closets; thus the type known as a plain hopper or bowl is as easily molded as the bowl for a lavatory. The syphon type of bowl may also be perfected in concrete, using a slightly different form than is usually employed; in this the trap or syphon is molded as a separate unit and upon this the bowl is placed.

A strong competitor to the porcelain kitchen sink may also be molded in nearly the same manner as employed for the lavatory bowl and apron, illustrated in Fig. 9. The outside form is built in the same manner as for a lavatory, with the inside form or core in a square box shape, to mold the inside surface of the sink. The molds should be lined with sheet metal to give a smooth molding surface, and also to protect the wood against the moisture in the concrete. The slab placed against the wall is molded in the same manner as employed for the lavatory slab, illustrated in Fig. 9. This must have openings molded in same to place the bibbs and water supply pipes for sink. The bottom of sink should have the strainer or waste pipe opening molded in same, or the strainer may be placed at the time the concrete is poured and is then ready for connecting to waste pipe.

Lavatories, closet bowls or hoppers, as well as kitchen sinks, should be reinforced with wire lath or expanded metal lath, thus permitting the work to be amply strong, but without excessive weight.

MOLDING CONCRETE LAUNDRY TUBS

The style of laundry tub illustrated in Fig. 10, is easily molded in concrete for either a two or three part tub, as may be desired. This tub, when carefully molded, is fully the equal of a composition laundry tub, and for the practical use to

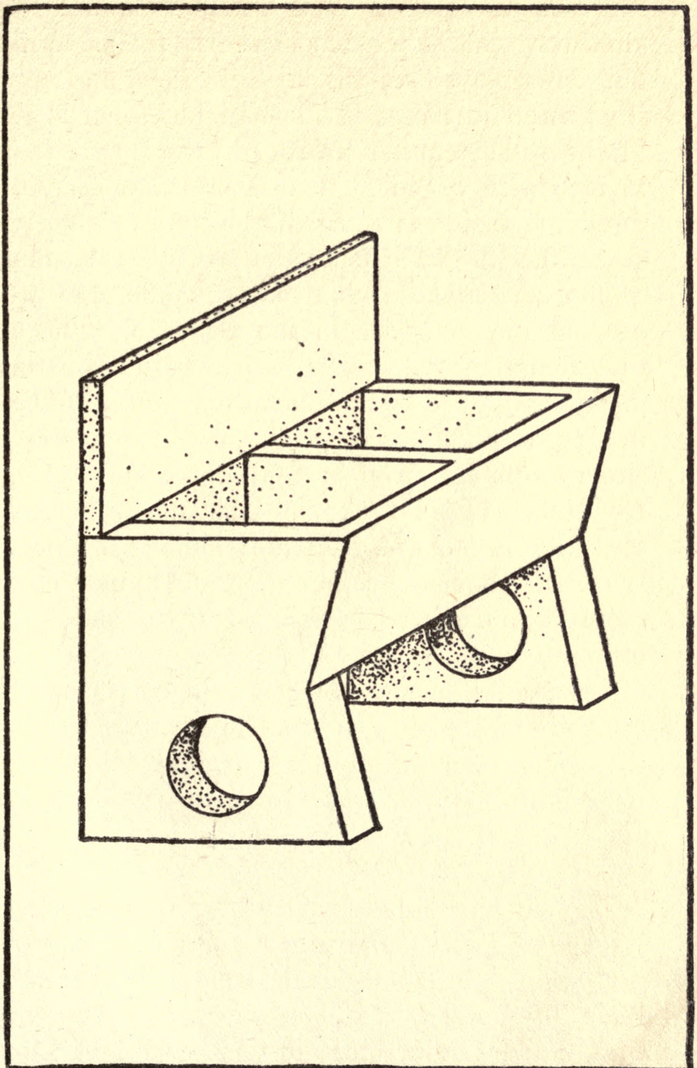

Fig. 10.—Laundry tub or tray molded in concrete.

which it is to be applied, it would be a strong rival of the porcelain tub, as the price would aid in making it popular.

The entire length of the tub is 60 inches over all; the walls are made 2 inches in thickness, and reinforced with wire lath or expanded metal lath. Each compartment is 27x24 inches and 16 inches deep, making the total height of the tub from the floor, 3 feet 2 inches, with the legs 20 inches in height, and the tub above same 18 inches high upon the outside. The legs are molded 4 inches thick, and in the manner illustrated, or any other form the worker may desire.

The slab at the back is 12x60 inches and 1½ inches thick. This is best when molded separate from the tub and then attached to the wall with screws, above the top of the compartments of tub. Openings should be molded in the slab for placing the bibbs and pipes for water supply, also openings in the bottom of each compartment for placing the waste pipe to tub. These may be arranged by inserting a short piece of gas pipe, previously well greased, into the green concrete at the point the opening is desired.

This tub, in either the two or three compartment styles, is molded in the manner shown in Fig. 11. The cores are made of wood, covered with sheet metal, in size equal to the inside dimensions of each compartment of the tub. The core is made convex on the top, so to mold the bottom

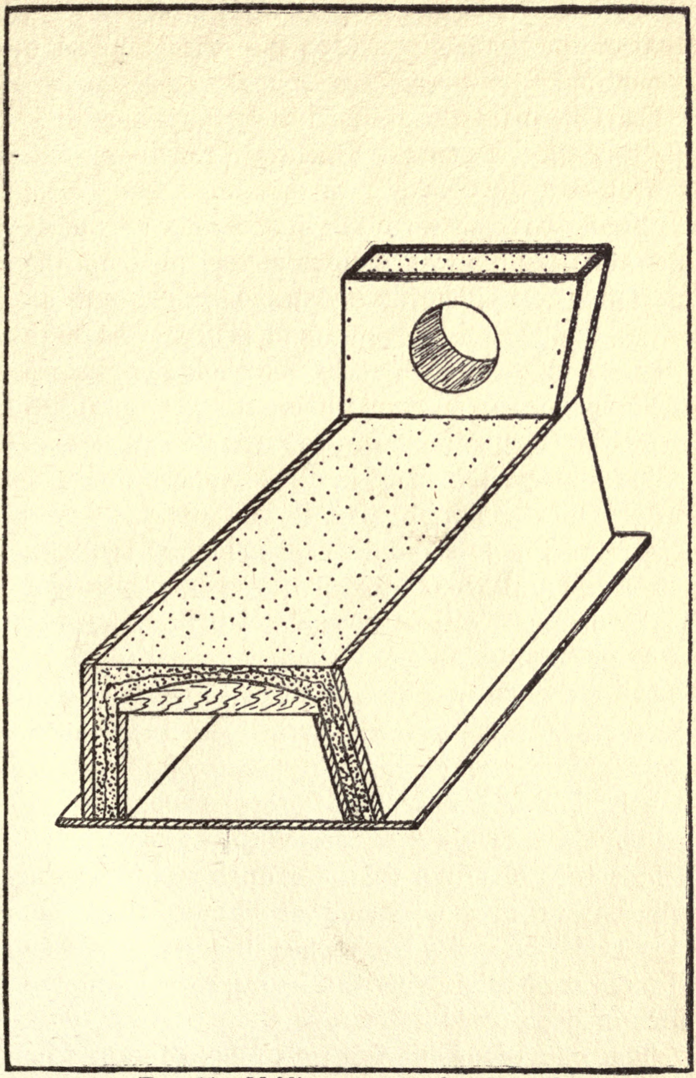

FIG. 11.—Molding concrete laundry tub.

of the tub in a concave form, which makes it far more satisfactory, enabling the tub to be easily emptied of all waste water. The convex part of core is easily made by cutting two strips of wood in that form and then covering with heavy sheet metal, to form the molding surface.

The cores are inverted upon the molding board at the proper distance apart, where they are held by blocks nailed to the molding board, to prevent the cores from slipping out of position when the concrete is tamped or poured into the mold. The back and front sides of outside mold are easily made of straight boards as forms, with wood mouldings along the edges to give a circular edge to the tub, if that is desired.

The two ends of the tub are cut from lumber in an exact outline of the form desired; these project 20 inches above the form for main body of tub, and an extra form for legs is spaced 4 inches from the end form, so as to mold the legs of tub at each end of same, 20x24 inches, and 4 inches thick. A circle or any other shape may be cut in the center of the molds for legs, and a sheet of metal bent to fit into same, thus molding any opening in the legs that the worker may desire. This opening is of advantage when placing the waste pipe, and also makes the complete tub lighter in weight, with the legs amply strong for the purpose.

The reinforcement is easily placed, as the tub

is molded bottom side upward, and thus every portion of same is within sight of the operator when placing the concrete.

The wood parts of mold should be well protected against moisture, by coating with a good oil compound, such as equal parts of petroleum and linseed oil; giving the wood two or three coats before using the mold and then a light coating each time before the mold is to be used. This not only prevents the wood portions of mold from warping and checking, but also prevents the concrete from adhering to the wood, caused by unprotected wood absorbing the moisture from the concrete and carrying with it particles of cement, which penetrate the fibres of the wood and thus bond the outside concrete to the wood molding surface. This causes the surface of the cast to scale or break off pieces when the molds are removed. The oil coating prevents this trouble and secures a good cast from wood molds, that have been treated each time before using.

MOLDING A COMPLETE AQUARIUM

The style of aquarium shown in Fig. 12 is as easily and simply molded as any square design in concrete. This is best when molded with glass inserted into the sides of same, and if desired, also in both ends of the aquarium. The top is ornamented by lining the edge of mold with stock wood mouldings to perfect the outline desired.

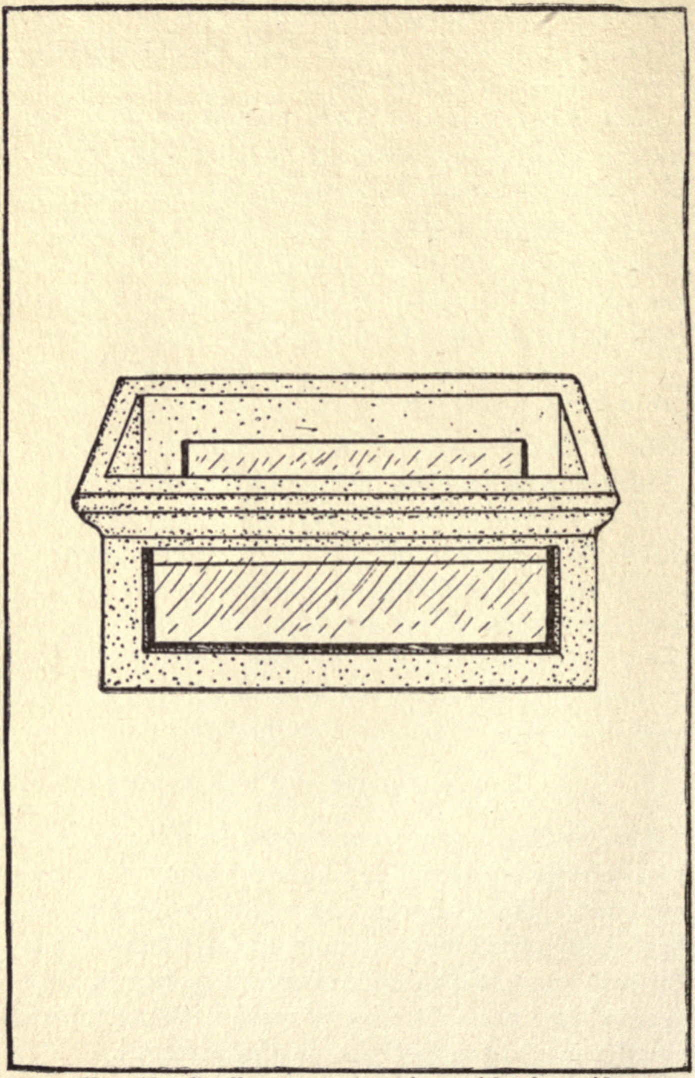

FIG. 12.—Small concrete aquarium with glass sides.

This aquarium is designed to be placed upon a pedestal, hence is not constructed upon a large scale, the size varying to suit the wishes of the worker.

The details for this style of aquarium are clearly shown in Fig. 13, also the manner of inserting the glass sides in same. The forms are constructed of wood, in nearly the same manner as if a panel was to be molded in the concrete wall of cast. The edges of the glass are then dipped in a cement composed of one part tallow melted with two parts of rosin, the dipped portion of the glass should be equal to the depth it is to be imbedded in the concrete along each edge. The concrete for the bottom of aquarium is placed, and then the core is inserted inside the outside forms, and to rest upon the concrete placed for bottom of cast.

The sheets of glass are then slipped between the two boards that mold the opening in sides, with the edges of the glass projecting upon each side of the panel boards, and also the bottom edge of glass pressed into the concrete placed for bottom of aquarium. Thus the glass is firmly imbedded in the cement at all points. The mixture of rosin and tallow makes an elastic putty, or cement, that will permit the concrete to expand without breaking the water-tight joint. The putty must be applied hot, and as this is also applied to the point where glass is imbedded in the concrete, the sides

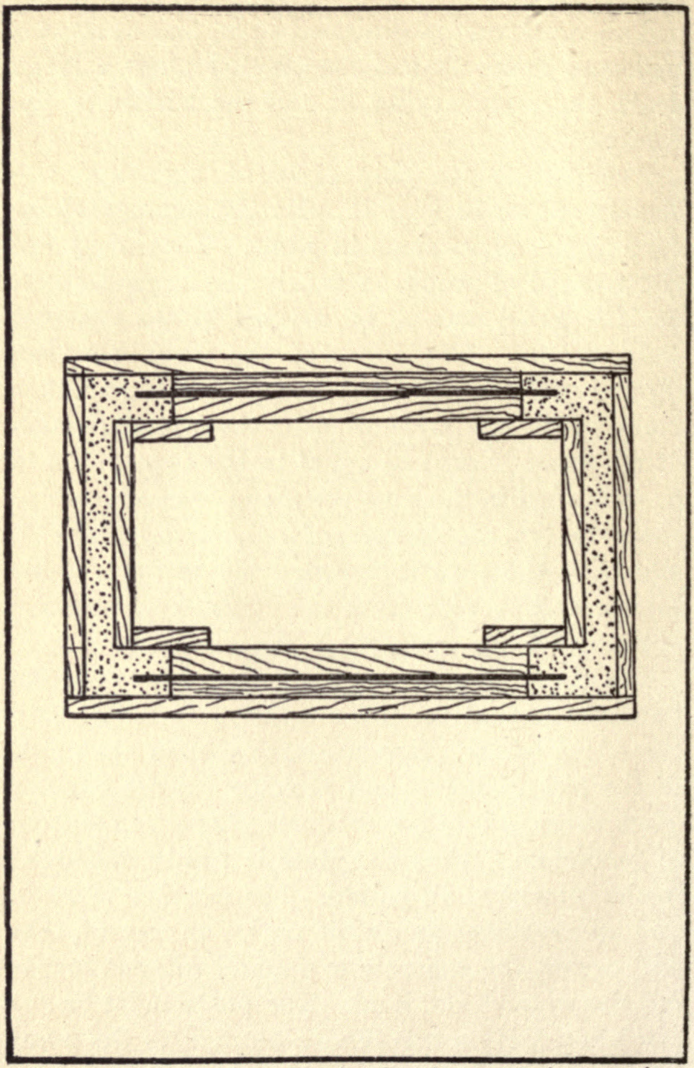

FIG. 13.—Manner of placing the glass in a concrete acquarium.

are sealed against the water escaping, in the same manner as putty perfects a water-tight joint in the ordinary window sash.

The walls of aquarium may be reinforced with wire cloth of $\frac{1}{2}$-inch mesh, or expanded metal lath, if the size of wall will permit its use. This permits the thickness of wall to be from $1\frac{1}{4}$ to 2 inches in thickness, as may be demanded by the size of the work to be molded. As shown in Fig. 13, the core is built in sections. These are held together with screws when molding the aquarium; thus permitting the core to be taken apart when removing from the complete cast, and lessening the danger of injuring the work, as would be the case if the core was not divided in this manner.

DESIGN FOR A LARGE CONCRETE AQUARIUM

At Fig. 14 is shown a simple and most excellent design for a large concrete aquarium. As will be noted from the illustration, there is ample space underneath the tank to place the water supply pipes. The bottom of tank is placed at the correct height for its contents to be viewed easily, with the bottom of tank about 8 inches in width, and from that sloping upward in a gentle declivity to the top. This compels the fish or other aquatic inhabitants of the tank to stay close to the glass side, where they may be the more easily viewed.

This style of aquarium is designed to stand

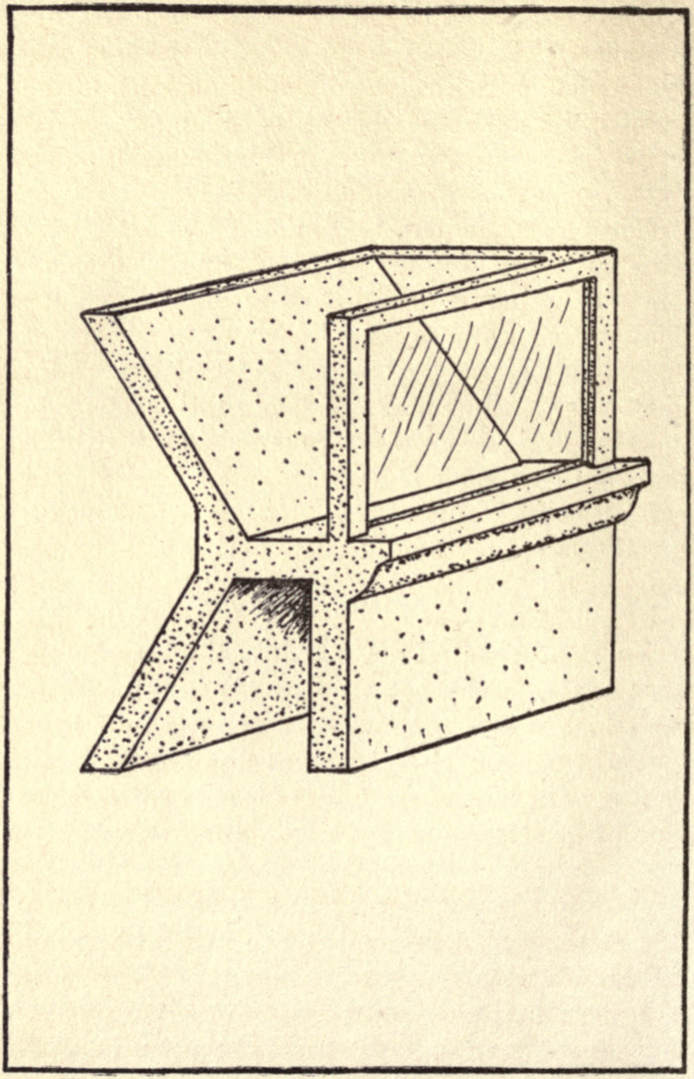

FIG. 14.—Sectional view of a large concrete aquarium.

against the wall, thus making it practical for any public structure. The ledge upon one side is easily molded by using wood mouldings inside the mold at that point. The glass side may be inserted in the same manner as for the small aquarium, which was illustrated in Fig. 13.

This aquarium may be built in sections, with partition walls at equal distances apart, so to accommodate many different species of fish, etc. The vertical walls for the front and partitions of the tank may be $2\frac{1}{2}$ inches in thickness for a small size of aquarium, and from this varying to 3 inches for larger sizes, when reinforced with metal lath imbedded into the wall. The sloping wall at back of tank should be from 3 to 4 inches in thickness, and amply reinforced with expanded metal lath. The floor of tank is molded from $4\frac{1}{2}$ to 6 inches in thickness, depending upon the size of the aquarium. The legs or walls supporting the tank are best when molded $4\frac{1}{2}$ to 5 inches in thickness; the sloping wall at back should have openings not only to admit the supply pipes, but also to permit any one to enter same so to make repairs to these pipes when it is needed.

CONCRETE AQUARIUMS FOR OUTSIDE USE

A method of constructing concrete aquariums for outside use is shown in Fig. 15. These may be either square or in any other form the worker may desire, and by constructing in a series with

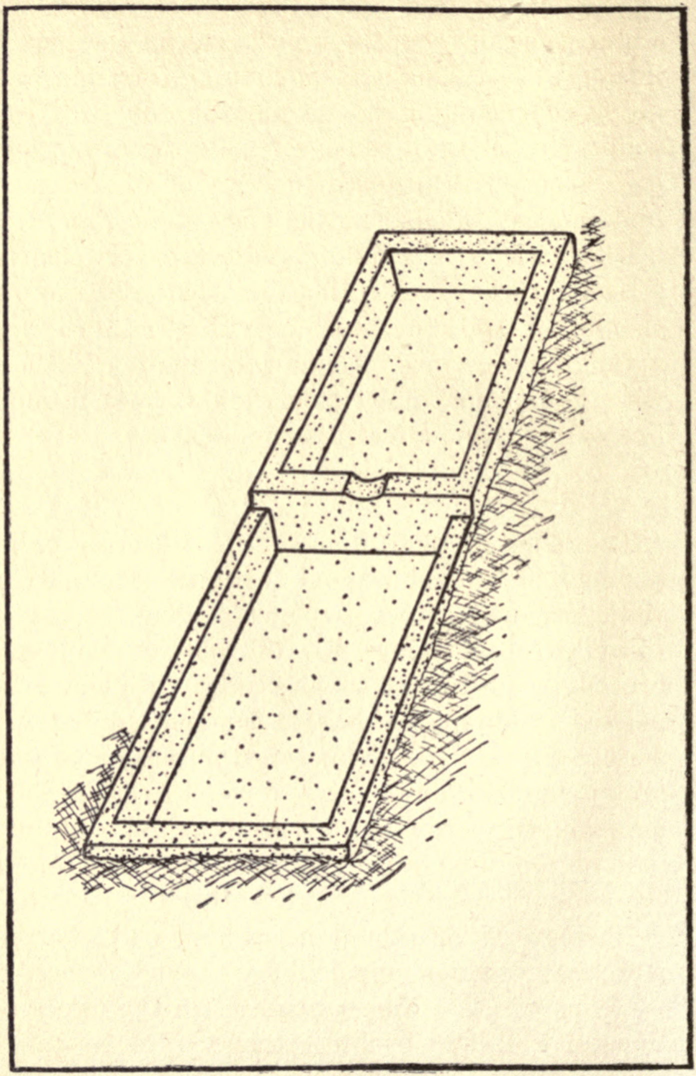

FIG. 15.—Method of arranging concrete aquariums.

each one slightly higher than those below, the water can run from the upper tank to the lowest in the series. This is of advantage for trout and all fish demanding a constant supply of fresh water, the series of tanks securing the advantage of a brook with different species of fish in each tank, and all filled from the one supply pipe.

The manner of molding these tanks is clearly shown in the illustration, so that the worker should have no difficulty in perfecting same. By arranging the tanks or aquariums upon a terrace, with the top edge of each one even with the ground line of lawn, the effect is very pleasing.

MOLDING CONCRETE NATATORIUMS

The usual method of molding a concrete natatorium or swimming pool, with the method of water-proofing same, is shown in Fig. 16. The forms are constructed for the outside wall and braced in position, the core form is then suspended inside of the outside centering, by strips across the top. The concrete for bottom of the tank is first placed for about one-half of its thickness, and the core forms set so to mold about one-half of the outside wall, or that portion next to the outside centering.

The core form is built in sections so to be the more easily taken apart and removed from the work, as well as to be adjustable to the two sections of wall built by this method.

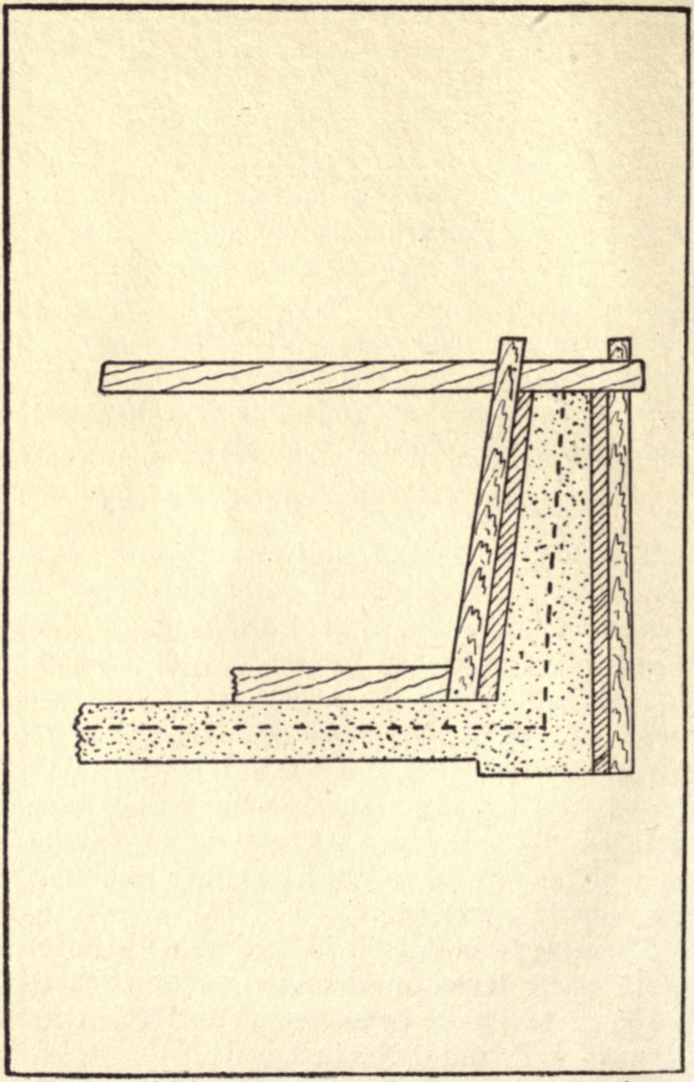

Fig. 16.—Molding and water-proofing a concrete natatorium.

When the concrete has hardened enough to permit, the core form is removed, and the inside of the tank given a thick coat of asphalt, or even hot tar, tarred felt, or some perfect water-proofing material that will also act as a binder or adhesive between the two layers of concrete. The balance or second layer of the floor is then laid upon this asphalt coating and the core erected to complete the wall to the desired thickness, the concrete being placed for same as soon as the asphalt coating is in place.

This method places an absolute water-proof layer of material between the two sections of wall and floor, as shown by the dotted lines in Fig. 16. By having it nearly in the center of wall each layer of concrete is thick enough to stand the loading without cracking, even if the bond between layers is not perfect.

The concrete pool or tank should be sloping with the greatest width at the top, so that in event of the water in same freezing at any time, the pressure would be far less than if the sides were vertical.

The outside wall should have a footing of sufficient width to support the wall. This must rest upon solid ground or a foundation wall that is amply strong enough for the load, so that there is no possible danger of the wall settling and thus causing the concrete to crack and injure the usefulness of the work. Where there is any danger

from this cause, or in large pools of this kind, the work should have ample reinforcement by tying expanded metal or wire lath to steel rods or bars spaced at the proper distance apart to take all the strain.

The concrete for the foundation may be mixed 1:3:6, using sharp sand, running from coarse to fine, and gravel not to exceed 2 inches in diameter, where the foundation walls are placed in a trench and below ground. This is covered with a 6-inch course of 1:2:4 mixture, well tamped, at the ground line. The body of the large pool may be built of well graded aggregates in the proportions of 1:2:4, using gravel or broken stone as the large aggregate. This is plastered upon the inside with a coating of one part Portland cement to two parts of clean, sharp sand. The concrete must be mixed wet and well tamped or forced into place, so to reduce the amount of voids, allowing the forms to remain about two to three days, so to permit the concrete to harden before removing to apply the plaster coat.

Openings for inlet and outlet are made by inserting short sections of iron pipe in the concrete, or by using a tapering wood plug or form for opening. These should be well greased, so to prevent the concrete from adhering to same.

WATER-PROOF CONCRETE

Concrete that is made properly, so to secure the maximum density, is practically impervious to water with a low pressure. In this regard the proper proportioning of the materials, grading the aggregates so to leave the least percentage of voids, care and thoroughness in mixing, and the use of water in a quanity ample to thoroughly wet the mixture, are of the greatest importance in securing a dense and water-proof concrete. It is also of importance that the concrete should be a rich mix, where the work will permit, and if this is not possible, as upon large tanks, the inside surface should be plastered with a rich mixture.

A rich mixture of concrete where subjected to a low water pressure is usually impermeable, and this increases with the age of the work.

Where the joints occur in the work, special care should be given to the water-proofing, so that water-tightness may be assured.

The water pressure against the surface of the concrete, must be considered in estimating the necessary water-proofing treatment. This is usually from 15 pounds to 156 pounds per square foot of wall surface, and with a lifting pressure under a floor of 31 pounds to 312 pounds per square foot, for a hydrostatic head of 6 inches to 5 feet; for a head up to 10 feet, the pressure against the wall per square foot will be up to 312 pounds, and

under a floor this will be doubled, or 624 pounds to the square foot. With a head of 15 feet, the wall pressure will be 468 pounds against each square foot of the wall surface; 20 feet gives a wall pressure of 625 pounds; 25 feet a pressure of 781 pounds to the square foot of wall surface. With a hydrostatic head of 30 feet, the pressure against the wall will be 937 pounds; above 30 feet in hydrostatic head the average pressure is easily estimated by multiplying the pressure at 20 feet, or 625 pounds, by the number of times 20 feet is contained in the estimated hydrostatic head. The lifting or pressure under a floor surface is usually estimated at double the water pressure against a vertical wall.

VARIOUS METHODS OF WATER-PROOFING

Among the oldest methods of surface treatment processes for water-proofing concrete, the Sylvester process has been the most universally employed. This required the application of alternate coatings of soap and alum solutions, applied hot. The castile soap is dissolved in hot water, using three-quarters of one pound to each gallon of water. This is spread over the surface with a brush. About 24 hours later, a solution of 8 ounces of powdered alum to each four gallons of water is applied over the soap coating. These alternate coatings are repeated at intervals of 24 hours apart, usually about four coats of both

the soap and alum solutions is demanded to secure the desired result.

Another method of employing this process is to add one pound of the powdered alum to each sack of cement used, and mixing with the water used for the concrete one per cent. of ordinary soft soap.

To tanks, boiled linseed oil, applied in successive coatings, has also been successful, as well as the application of tar and asphalt. A wash or coating of one part green vitriol in three to four parts of water has also secured success in water-proofing many small articles, where the surface was of no great area.

The use of hydrated lime is of value when 10% to 25% has been added to the concrete mixture. This, by its exceptional fineness, fills the voids in the work that would otherwise be open for the passage of moisture.

A wash of Portland cement and hydrated lime, mixed one part lime, by weight, to two parts of Portland cement, and applied to the wall surface with a brush, has been very effective in water-proofing the concrete where the water pressure was not too great. This wash or coating will be far more effective and spread easier, filling the pores and defects in the work and making a smoother surface, if 2 ounces of powdered alum has been added to each gallon of the brush coat.

A number of the water-proofing and stone finish

compounds now in use are made up of hydrated lime and Portland cement as the base of the compound. The success of these finishes proves the value of the lime and cement brush coat as a water-proofing coating, when thoroughly and carefully applied.

The use of paraffin as a water-proofing material has met with good success, and for small articles the process would be of use and value. There are various methods of applying the paraffin to the concrete, either by keeping it in a melted state, which may be done by subjecting the vessel holding same to a gentle heat while the coating is placed over the surface with a brush, or by cutting the paraffin into very small pieces and placing in gasoline or any quickly evaporated or volatilized fluid and then applying this to the surface; as soon as the gasoline has evaporated, so it is safe to do so, a torch can be used for heating the concrete surface and thus causing the paraffin to penetrate the pores of the concrete, where it immediately hardens and completely fills the openings, thus preventing the passage of water.

Another method is to heat the concrete surface with the torch, before applying the paraffin, and then going over the work again with the torch to complete the process. This has an advantage in the fact that the paraffin will remain in a liquid or melted state longer than where the wall

has been subjected to the heat but once, thus enabling it to penetrate to a greater depth below the concrete surface and increase the value of the protective and water-proof coating.

The use of sodium silicate (water glass) in the proportion of one part to three parts of water and this applied to the concrete surface, has given excellent results. This is a very cheap method of water-proofing, as the usual cost of the water glass is from one to two cents a pound, depending upon the quantity purchased. This readily mixes with water, thinning the sodium silicate so to the more readily enter the pores of the concrete.

Several applications should be made, so to fill the pores of the work. This will result in a portion of the material remaining upon the surface, and may be flushed off with water, or, better yet, sprayed with chloride of calcium (chloride of lime), which forms a chemical reaction when in contact with the water glass, hardening the surface of the concrete and making a surface impervious to moisture. While the application of the chloride of lime will lighten the surface of the concrete, yet it supplies the necessary lime to harden the sodium silicate and form an insoluble coating upon the concrete surface. Where the chloride of lime solution is not applied, the water glass that is flushed to the surface of the concrete is washed off with water, leaving only the sodium silicate solution that has penetrated the pores,

and from contact with the lime and alkalies in the concrete, has hardened into an insoluble coating that will render the concrete impervious to water.

Small articles may be immersed in the sodium silicate bath, and by remaining in same from 12 to 24 hours, will absorb more of the solution than if it is applied as a surface treatment, producing more satisfactory results.

In using any water-proofing material, it must be remembered that the porosity of the concrete must determine the success or failure of the water-proofing material. Thus, a lean mixture of concrete with poorly graded aggregates and indifferent care in the mixing and placing, will produce a greater percentage of voids in the work. This demands more material, labor and care to water-proof effectively than if the concrete is of the maximum density. It will thus be seen that the water-proofing problem must be judged in accordance with the condition of the wall, and that a treatment that was effective on a perfect wall would be a failure when applied in the same manner to a far more porous surface. The one safe and effective rule for a water-proof surface is to produce the maximum density to the concrete. The use of a rich and wet mixture with clean and properly graded aggregates will go far towards the purpose desired.

PATENT COMPOUNDS FOR WATER-PROOFING

A brief mention of the various special compounds on the market may interest the reader. While it would not be within my province to advise the use of any one compound instead of another, yet the brief description given may enable the reader to decide upon the one most suitable to his needs.

Among the products intended to be incorporated with the concrete we have a number in powder form, thus ANHYDRA is a white powder resembling talcum powder, and is added to the neat cement in the proportion of about two per cent., by weight, to the weight of the cement used, or 2 pounds to the sack.

There are a number of brands of hydrated lime placed upon the market under different trade names, and which demand that from 10 to 25 per cent., by weight, be incorporated with the cement used.

In the dry powder form we have HYDRATITE, which is mixed with the dry cement in the proportion of about 2 pounds to the sack of cement, and then the damp sand added to same. The IDEAL WATER-PROOF FILLER is also mixed with the dry cement in proportions of 1 to 2 pounds to each sack of cement. MEDUSA WATER-PROOF COMPOUND is another powder form of water-proofing compound, and is usu-

ally mixed with the dry cement in a proportion of 1 to 2 pounds to each sack of cement used. TOXEMENT is said to be effective when mixed 2 pounds to the sack of cement, while dry.

AQUABAR is a paste-like solution, which is placed in the water employed for mixing the concrete, using one part of the compound to twenty-four parts water.

The compound sold under the trade name of ANTI-HYDRO is mixed in the proportions of one part of the solution to ten parts of water, used in mixing the cement. This is largely used in plaster coatings, applying a coating of neat cement; a scratch coat, $3/8$ of an inch thick, mixed 1:2, and a finish coat $1/4$ of an inch thick, mixed 1:1, using the compound in the water employed for mixing the mortar.

Another dry powder compound is sold as "TRUS-CON" WATER-PROOFING FILLER, and is mixed with the cement while in a dry state, in the proportion of 2 pounds to the sack. This is often employed in plaster coatings as well.

Among the compounds employed for the surface treatment of concrete, ANTIHYDRINE is described as a high grade of asphalt in combination with other chemicals that forms a glossy and impervious coating over the concrete surface, when applied with a brush, each gallon covering about 100 square feet.

CEMELINE is a liquid water-proofing mate-

rial that is supplied in various colors and is employed with CEALTITE as a filler or putty-like composition for sealing the joints and cracks in the wall.

The DEHYDRATINE DAMP-RESISTING COMPOUNDS are heavy black liquids that are applied cold, with a brush, with a covering capacity of 50 to 80 square feet to the gallon. DIAMOND WATER-PROOFING is a mineral solution that is claimed for it to be insoluble in water and without containing any grease, oil or paraffin. It is applied with a brush, like ordinary paint.

IRONITE is another mineral compound in the form of a fine powder, which is mixed with water to the consistency of a brush coat. When first applied, the color is black, but in time this changes to a brown shade. This is claimed to effectively resist water pressure. LIQUID KONKERIT is also spread like paint, as well as TE-PE-CO., the latter having a covering capacity of 85 to 125 square feet to the gallon.

While there are a number of other compounds for which perfect results are claimed when applied to the concrete surface, yet in the main, any water-proofing mixture must largely depend upon the density of the concrete for its success, as where the pores or voids are larger than will permit the filler or compound to perfectly close same, effective water-proofing cannot be expected, thus

bringing the worker back to the fact that unless the concrete has been properly made, or at least protected by a rich and dense plaster coating, impermeability cannot be secured with certain success.

INDEX

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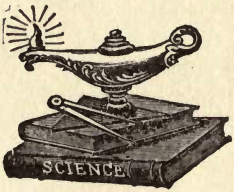

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